For areas with relatively uniform appearance, such as cheeks **152**, fewer features are chosen due to higher redundancy.

In summary, the disclosed embodiments include a novel unsupervised feature selection algorithm which may be incorporated into least-square-based congealing algorithms for use in object recognition and detection. For example, FIG. **9** illustrates a method **160**, which includes the disclosed techniques. Specifically, as represented by block **162**, a graph having features as the vertices is constructed. Thereafter, the connectivity between the vertices is determined by the maximum information compression index, as represented by block **164**. The graph is partitioned into subsets using power iteration clustering, and a representative feature is selected from each subset, as represented by block **166**. Subsequently, as indicated by block **168**, the subsets of the feature representation are used for image congealing. In other words, only a portion of the original feature presentation is used for congealing in a least-square-based congealing algorithm. In this manner, irrelevant and/or redundant features may be reduced or removed from the congealing process.

With the massive image data available for various object classes, image congealing is a key technology to automatically estimate the rigid or non-rigid deformation of the object instances. With an integrated and efficient unsupervised feature selection, the proposed congealing algorithm opens the potential of effectively performing congealing for a large image ensemble, despite the high dimensionality in the original feature representation. For example, with merely 3% of the original features, the proposed congealing algorithm can complete in less than 40% of the time as conventional congealing methods without feature selection, yet still improve the accuracy and robustness of congealing.

What is claimed is:

1. A method, comprising:

integrating an unsupervised feature selection algorithm with a least-square based congealing algorithm;

selecting a subset of features from an initial feature representation with the unsupervised feature selection algorithm; and

executing the least-square based congealing algorithm to estimate warping parameters for a plurality of images in an ensemble using the subset of features.

2. The method of claim **1**, wherein the subset of features comprises less than approximately 3% of the initial feature representation.

3. The method of claim **1**, wherein the subset of features comprises a first representative feature from a first subset of the initial feature representation and a second representative feature from a second subset of the initial feature representation.

4. The method of claim **3**, comprising selecting the first representative feature and the second representative feature based on a feature similarity measure.

5. The method of claim **3**, comprising dividing the initial feature representation into the first subset and the second subset automatically.

6. The method of claim **1**, wherein selecting a subset of features from an initial feature representation with the unsupervised feature selection algorithm comprises using a filter method to select the subset of features from the initial feature representation.

7. The method of claim **1**, wherein using a filter method to select the subset of features from the initial feature representation comprises removing irrelevant features and/or redundant features of the initial feature representation from the subset of features.

8. The method of claim **1**, wherein executing the least-square based congealing algorithm to estimate warping parameters for the plurality of images in the ensemble using the subset of features comprises estimating initial warping parameters, computing warping parameter updates, and updating the initial warping parameters to calculate current warping parameters.

9. A method, comprising:

incorporating an unsupervised feature selection algorithm into an image congealing algorithm;

executing the unsupervised feature selection algorithm, comprising:

constructing a graph having features of an image as vertices;

determining a connectivity between the vertices;

partitioning the graph into two or more subsets of features; and

selecting representative features from each subset of features; and

executing the image congealing algorithm to estimate warping parameters for the image using the representative features.

10. The method of claim **9**, wherein the image congealing algorithm is a least-square based congealing algorithm.

11. The method of claim **9**, comprising determining the connectivity between the vertices using a feature similarity measure.

12. The method of claim **11**, wherein the feature similarity measure comprises a maximum information compression index, a heuristic algorithm, a spectral clustering algorithm, or any combination thereof.

13. The method of claim **9**, comprising partitioning the graph into two or more subsets of features using a power iteration clustering algorithm, wherein the power iteration clustering algorithm comprises a perturbation enhancement.

14. The method of claim **9**, comprising partitioning the graph into two or more subsets of features using a Dirichlet process mixture model.

15. The method of claim **9**, comprising executing multiple iterations of the image congealing algorithm and executing the unsupervised feature selection algorithm before each iteration of the image congealing algorithm.

16. The method of claim **9**, wherein a number of the two or more subsets of features is determined automatically.

17. The method of claim **9**, wherein a number of the two or more subsets of features is predetermined, and a number of representative features from each subset of features is predetermined.

18. A method, comprising:

minimizing a cost function of an image congealing process, comprising:

selecting a subgroup of features for each of a plurality of original feature representations with an unsupervised feature selection algorithm, wherein each of the plurality of original feature representations corresponds to a respective image of a plurality of images in an ensemble; and

estimating warping parameters for each of the plurality of images using the subgroups of features in a least-square-based congealing algorithm.

19. The method of claim **18**, wherein the unsupervised feature selection algorithm comprises:

generating a graph for each image, wherein vertices of the graph comprise the features of the original feature representation;

determining connectivity between the vertices with a maximum information compression index;